

- a.r.* Posterior renal arteries.  
*bl'*. Allantoic bladder.  
*bl''*. Orifice of the same.  
*cl'*. Cloaca.  
*cl''*. Epidermal portion of the same.  
*cl'''*. Oviducal recess of the same.  
*dv'*. Cæcum coli (or its probable homologue).  
*dv''*. Appendix digitiformis.  
*f.* Longitudinal fold in roof of large intestine.  
*il.* Large intestine.  
*is.* Small intestine.  
*od'*. Left oviduct.  
*od''*. Right oviduct.  
*p.* Pelvic girdle.  
*st'*. Stomach, cardiac sac.  
*st''*. Stomach, pyloric sac.  
*vi.* Intestinal (spiral) valve.  
*vic.* Ileo-colic valve.

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On the Tongues of the British Hymenoptera Anthophila.  
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[Read 17th April, 1890.]

(PLATES III.-X.)

IN Vol. XVII. of this Journal Mr. Travers J. Briant has ably described the tongue of *Apis mellifica* and its anatomy, and I purpose in this paper to give descriptions of this organ in other British genera of Hymenoptera Anthophila, accompanied with figures carefully drawn from slides prepared by Mr. Enock, whose skill in this direction is well known. At the present time I know of no figures that, in any way, give an idea of the beauty and complexity of structure which characterize the different genera. The number and proportionate lengths of the joints of the palpi and the general form of the so-called lingua have been the only characters usually selected for generic determination, whereas the form of the *lora*, *submentum*, *scales of the maxillæ*, and *paraglossæ* afford additional characters quite as important, as will be seen by the accompanying Plates. As a general result from the study of these organs, it would appear that there is a gradual modification of form from the short bifid

tongue of the *Obtusilingues* to the long filiform one of the higher *Apidæ*; that the lora or  $\Lambda$ -shaped hinge by which the mentum and lingua can be projected is more developed in the higher genera, and accordingly allows of greater play for those organs; that the basal joints of the labial palpi are flattened and sheath-like in the higher genera, so as to form a protection for the base of the tongue; and that the paraglossæ also tend, in these genera, to take a sheath-like form. In the early genera the lora can scarcely be said to exist definitely at all, the membrane between the cardines being merely chitinized towards the apex and raised so as to form an arch which acts as a hinge; in *Halictus*, *Sphécodes*, &c. even this is absent (see descriptions of those genera). There appears to be a regular progression in development, but this progression is arrested here and there by certain genera which seem to defy one to find a proper place for them. Such a genus is *Rophites*. It has the labial palpi of the higher *Apidæ*, paraglossæ quite unlike in form to those of any other genus, no definite lora, in this respect resembling *Sphécodes* and *Halictus*, to which latter genus it greatly assimilates in general appearance, and a tongue as long as that of any of the *Apidæ*. *Panurgus*, again, is quite aberrant and difficult to localize in any arrangement, as, apart from its lingual peculiarities, its genital armature is quite unlike that of any of the genera that could be considered allied to it. These special features, however, will be described more fully under each genus.

The cibarial apparatus in all the genera is arranged on the same general plan as in *Apis*, but varies very considerably in its details, both as to the shape and the relative proportions of its component parts, and it is on the characters afforded by some of these variations that many of the different genera have been established. I propose here to give a general description of the apparatus, leaving the special features of each genus to be considered further on.

At the back of the head, behind the face, between the occipital foramen and the mandibles, is a deep wide groove, with abruptly truncate sides, which lie nearly parallel to each other; it is determined somewhat semicircularly at its basal or occipital end, *i.e.* that nearest the juncture of the head and thorax, but is open at its apical end, except when closed by the mandibles folding across it. The floor of the groove is the posterior surface of the actual wall of the face. It is in this groove that the cibarial

apparatus lies folded when at rest, and I shall here refer to it as the oral groove. By gently pulling the apex of the tongue, the whole apparatus may be gradually unfolded, and it will then be seen that there is a membrane investing the entire base of the apparatus and completely covering the oral groove; this is best seen when the tongue is fully extended. On dissecting the head it appears that this membrane is attached to the back of the clypeus on each side, whence it arches downwards and forms what has usually been termed the hypopharynx, between which and the epipharynx is a very small opening, and it is through this opening only that there is communication with the gula, except through the actual lingua itself. The cibarial apparatus may, in fact, be compared to a funnel-shaped bag strengthened by various sclerites above and below (which also aid in its folding up), and prolonged at its apex into the semitubular mentum and lingua. The arrangement of the various sclerites is as follows. I shall commence with those on the underside:—

On the anterior edge (*i. e.* that lying furthest from the back of the head) of each of the truncatures that bound the oral groove is an emargination, into which articulates an elongate joint, these joints are called the *cardines*; each *cardo* is considerably widened at its apical end, and produced into two unequal processes. On these widened portions swing the *lora*, and from them depend the *maxillæ*, each of which consists of a sheath-like basal portion and a blade-like apex, between which on the external side the *maxillary palpus* is inserted. The *lora* are two narrow joints united so as to form a  $\blacktriangle$ -shaped body, from the angle of which is suspended the mentum, &c.; these can swing over on their feet which rest on the apices of the *cardines*, and by this motion the tongue can be projected for twice the length of the  $\blacktriangle$ . They vary very much in their length, and in some of the genera of the short-tongued bees are scarcely developed; but in only four British genera are they actually wanting, viz. in *Halictus* and *Sphecodes*, and in *Dufourea* and *Rophites*, in which there appear to be no traces of them, and, in fact, there appears to be nothing to correspond to them in their office of lengthening the tongue; the membrane covering the space between the cardines, which in the other genera is simple, is here chitinized towards its centre into two straps, which are united to the submentum at their apices. From the angle of the *lora* hangs the *submentum*, which varies considerably in shape; although always more or less

widened towards the apex, it is sometimes quite short and triangular, at others many times longer than wide. It also varies in substance, in some genera being clear and hyaline, in others dark and opaque; it is short and more or less hyaline in the early genera of the short-tongued bees, and elongate in most of the true Apidæ, and in the somewhat aberrant short-tongued genera, such as *Macropis*, *Cilissa*, and *Dasyпода*; whereas in *Panurgus* again the short hyaline form shows itself, and in *Bombus*, *Psithyrus*, and *Apis*, although not hyaline, it is short and triangular. Beyond the submentum comes the mentum itself, which is brown, chitinous, and semitubular, and forms a supporting sheath for some of the softer parts of the apparatus to lie in; above, it is sometimes strengthened by elongate sclerites, as in *Megachile*, *Osmia*, &c.; it varies very little in form, being usually slightly narrowed and rounded at the base, truncate or produced into one or more lobes at the apex beneath; from either side of the apex extends one of the labial palpi, and from between them the so-called lingua. Near the base of the mentum on each side is attached a sclerite, which passes upwards between the maxillæ and thence under the labrum, where it is abruptly angulated, its apex lying just at the side of the anterior edge of the oral groove, close to the emargination into which the cardo articulates. These sclerites hold the upper part of the membranous bag expanded anteriorly when the tongue is extended. Huxley has called them "the sclerites of the hypopharynx." They are united to the maxillæ by the investing membrane, which just at the point of union on either side gives rise to a sort of scale which is often fringed with bristle-like hairs; these scales, which appear to exist in all our genera, although obsolete in *Apis*, seem to have been scarcely noticed by authors; they are very much developed in *Anthophora* and also in *Megachile*, *Osmia*, and their allies. Beyond the basal ends of these sclerites, and with their anterior extremities lying between them, are two others, which can only be seen when the clypeus and face and the top of the œsophagus are removed; they are what Huxley has called the "sclerites in the wall of the œsophagus." They converge posteriorly, and are somewhat hamate at their posterior ends; the membrane which lies between these forms the floor of the mouth. Anteriorly, this membrane is chitinized, and forms what has been called the hypopharyngeal plate; on this chitinized portion, which is slightly concave, may be



observed various papillæ, which at first sight look like punctures, and on each side is a nipple-shaped opening, through which the secretion from the salivary duct can pass. Beyond this chitinized plate is the opening into the œsophagus. We will now proceed to consider the lingua, which, as was stated above, extends beyond the mentum between the two labial palpi. The base of the lingua is ensheathed by the two paraglossæ; these vary very much in form: as may be seen by a reference to the figures of the various genera, a chitinous band extends across the base of the lingua in front, and terminates on each side below in a pointed process. The lingua varies much in form, from the short broad bifid organ of *Colletes* to the long narrow one of *Anthophora*. In all the genera the surface is traversed by fine ridges set with bristly hairs. The base of the lingua in the higher Apidæ is really ensheathed by three sets of appendages: 1st the maxillæ, 2nd the labial palpi, 3rd the paraglossæ; but in the short-tongued bees the labial palpi have no sheathing properties, all their joints being cylindrical.

I do not here propose to give any description of the functions &c. of the tongue, as these have been described by Mr. Bryaut, and I have confined myself to describing the position and general form of its skeleton. For clearness' sake I recapitulate the sclerites thus:—

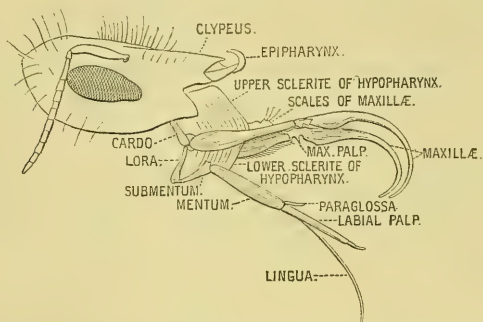
- a, a. *Cardines* articulated into an emargination in oral groove.
- b, b. *Lora* swinging on the dilated ends of the cardines.
- c, c. *Maxillæ* articulated to ends of cardines.
- c<sup>a</sup>, c<sup>a</sup>. *Scales of maxillæ* exerted from membrane at base of maxillæ.
- c<sup>b</sup>, c<sup>b</sup>. *Maxillary palpi* inserted between base and blade of maxillæ.
- d. *Submentum* attached to apex of lora.
- e. *Mentum* attached to apex of submentum.
- e<sup>a</sup>, e<sup>a</sup>. *Labial palpi* attached to apex of mentum laterally.
- f. *Lingua* attached to apex of mentum centrally.
- f<sup>a</sup>, f<sup>a</sup>. *Paraglossæ* ensheathing the base of the lingua.
- f<sup>b</sup>. *Scleritic ring* forming a transverse band at the base of the lingua.
- g, g. *Sclerites of hypopharynx* originating on the margin of the oral groove, passing between maxillæ and uniting with mentum near its base.

h, h. *Epipharynx* projecting under the labrum.

i. *Labrum* attached to the clypeus.

j, j. *Sclerites in the wall of the œsophagus* forming the floor of the mouth.

It only remains now for me to state that it is to the beautiful preparations of Mr. Enock that all the merit of this paper is due, and to thank him cordially for doing the work so well.



Lateral diagrammatic view of head of *Bombus*: mandibles and labrum removed.

COLLETES, *Latr. Hist. Nat.* iii. p. 372. (Pl. III. figs. 1, 2.)

Labrum transverse, broadly and bluntly angulated in front, densely fringed with long bristly hairs. Epipharynx visible beyond the hairs of the labrum, somewhat rounded in front, its extreme apex pointed. Sclerites of the hypopharynx much curved and twisted; the scales at the membranous base of the maxillæ represented by two or three strong bristly hairs. The maxillæ are rounded at the apex, and reach just to the base of the lingua, round the apex they are fringed with a row of short curved bristly hairs, and longer hairs, which show traces of branching, below them; their inner edge is very thin and membranous; their surface is impressed with irregularly disposed punctures; the reflexed under margin of the maxillæ bears a row of long curved bristles, these in a strong back light can be seen through the substance of the maxillæ from above. Maxillary palpi 6-jointed. Paraglossæ concave above, wide at the base, remotely punctured, their anterior margins with a row of deep punctures, from each of which springs a curved bristle. The lingua is deeply cleft at the apex, its base is convex and in the form of an equilateral triangle, the base of the lingua being the apex of the

triangle; the base of the triangle or anterior margin is widely emarginate; projecting beyond this triangle is the apical portion of the lingua, which almost appears to be produced from under the basal canopy, *i. e.* it is on a lower level than it; it is slightly rounded at the sides and deeply and angularly cleft in the middle right into its base; the canopy and the surface of both the basal and apical portions are exceedingly finely ridged transversely, and set with very short bristles, and the apical portion is also covered and fringed round its edges with very fine soft long hairs. Mentum beneath about  $2\frac{1}{2}$  times as long as wide; labial palpi 4-jointed, the basal joint much wider and longer than the others. Submentum hyaline, short, and subtriangular. Lora short and not well-defined, as they gradually merge into the investing membrane which covers the space between the cardines, this membrane becoming gradually darker in colour, and scleritic as it approaches the lora.

PROSOPIS, *Fabr. Syst. Piez.* p. 293. (Pl. III. figs. 3-5.)

Labrum transverse, very slightly angulated in front, its anterior margin armed with a row of very strong testaceous spine-like hairs. Epipharynx extending beyond the spines of the labrum and somewhat pointed. Sclerites of the hypopharynx strongly developed, slightly curved above the maxillæ. Scales at the base of the maxillæ well developed, elongate, and fringed with long hairs; blades of the maxillæ short, somewhat sinuate on the external margin, their inner edge membranous, fringed with thick bristles round the apex, which is widely rounded. Surface impressed with a few irregularly disposed punctures. The reflexed under margin with a series of sharp bristles. Maxillary palpi 6-jointed. Paraglossæ elongate, about twice and a half as long as wide, not much narrowed to the apex, the apex fringed densely with fine hairs. Lingua very short and wide, its basal portion in the form of an obtuse-angled triangle, very finely ridged transversely and set with bristles, until near the apex, where the ridges and hairs stop, and are replaced by a wide band, which under a  $\frac{1}{4}$ -inch power is apparently glabrous, and its surface finely shagreened or rugose; the anterior margin of the basal portion or canopy is almost straight; the apical portion projects from beneath the canopy, much as in *Colletes*, but is very short and not deeply cleft, but only widely and

shallowly emarginate anteriorly; its surface finely ridged and clothed with long irregularly curved hairs. Beneath, the mentum is a good deal widened anteriorly, about twice and a half as long as wide; it has a strong ridge running nearly parallel to its external margin; labial palpi 4-jointed. The submentum is short and hyaline. Lora wanting: what acts as such is the thickened apical portion of the membrane which covers the space between the cardines; this thickened portion is convex, and so forms an arch at its apex, to the centre of which the submentum is attached; it is therefore evident that the play of the lora affords very little power of extension to the tongues of the species of this genus.

SPHECODES, *Latr. Hist. Nat.* xiii. p. 368. (Pl. III. figs. 6-8.)

Labrum at the base broader than long, its sides somewhat rounded and converging towards the apex; apical margin emarginate, sides and apical margin, except just the centre of the latter, bearing a row of thick spine-like bristles, these are situated just within the actual margin; epipharynx subtriangular. Sclerites of the hypopharynx double on each side, the outer one terminating below the apical margin of the labrum, and uniting, or nearly uniting, at its base with another sclerite, which passes diagonally down the side of the expanded membrane which invests the base of the cibarial apparatus; this membranous bag is peculiarly developed in this genus and *Halictus*, and its surface covered with transverse rows of very short bristly hairs; near the juncture of the two sclerites above mentioned, the membrane gives rise to two or three long upright bristles, which appear to me to represent the scales at the base of the maxillæ, which are so much more developed in the other genera. The maxillæ are rounded at the apex, their inner edge very finely and transparently membranous, the thicker portion of the maxillæ remotely punctured; palpi 6-jointed. Paraglossæ membranous and transparent, somewhat falcate. Lingua convex above, longer than wide, its sides rounded to the apex, which is somewhat bluntly pointed, its surface finely ridged, the ridges bearing rows of short bristles. Beneath, the mentum is not quite three times as long as wide; the labial palpi are 4-jointed; the submentum is very short and transparent, in fact it is not easy to trace its shape at all. The lora, so far as I can make out, do not exist at all, either in this genus or in *Halictus*. The cardines are very

long, and the membrane uniting them bears down the middle two darker chitinized straps, each of which narrows towards its apex, which is abruptly turned inwards, terminating just above the base of the submentum, so that there is no hinge by which the mentum &c. can be thrown forwards: possibly the elasticity of the membrane may be such that the bee by an extra effort can stretch it, but in any case the apparatus employed seems to be strangely different in these two genera from what it is in their allies.

*HALICTUS*, *Latr. Hist. Nat.* xiii. p. 364. (Pl. III. figs. 9-11.)

Almost exactly similar to *Sphécodes* in its oral arrangements, but with the labrum more transverse; the paraglossæ more developed and produced into two elongate parallel-sided processes densely fringed with branched hairs; lingua longer, its sides rounded nearly to the apex, then slightly sinuate, the hairs of the surface of the lingua also longer than in *Sphécodes*, and distinctly branched towards the apex, otherwise the description of that genus will apply in all essential points to this.

*ANDRENA*, *Fabr. Syst. Ent.* p. 376. (Pl. IV. figs. 1-3.)

Labrum transverse, fringed with long bristly hairs; epipharynx triangular. Scales at the base of the maxillæ well developed, elongate oval, bearing several long bristles, some of which are more or less branched. Maxillæ extending to about the widest part of the lingua, somewhat rounded at their apices and fringed with hairs, their inner edge narrowly membranous, and their reflexed under margin with a row of closely-set bristles observable through the transparent substance of the maxilla; palpi 6-jointed. Paraglossæ transparent, truncate at the base, which is margined with a narrow band of darker chitine, impressed with a row of punctures; apex of each produced into a lobe transversely ridged and set with short bristles like the lingua. Lingua a little more than twice as long as wide, finely ridged transversely, and clothed with short hairs, those at the apex longer. Beneath, with the mentum elongate, four times as long as wide at the apex; submentum elongate, hyaline. Lora represented by the apical triangular arch formed by the convex scleritic apical portion of the membrane investing the space between the cardines; in this character *Andrena* seems to approach closely to *Colletes* and *Prosopis*, but the ends of the



arch appear to rest on the apices of the cardines, and therefore the apparatus approaches more nearly in its arrangement to the lora of the higher Apidæ.

CILISSA, *Leach, Ed. Enc.* ix. p. 155. (Pl. IV. figs. 4-6.)

Labrum transverse; epipharynx triangular. Scales of the maxillæ dark and suboval, deeply foveated, set with a few bristly hairs; sclerites of the hypopharynx visible on each side of the labrum. Maxillary palpi 6-jointed; blades of the maxillæ rather short, wide at the base, gradually narrowing into a sharply-pointed apex, their surface punctured. Paraglossæ with a broad basal sheath, and an apical process fringed with long hairs. Lingua wide at the base, produced into a sharply-pointed apex, its sides slightly concave, clothed with hairs at the base, pointing towards the apex; at the apex with some of the hairs erect, giving it somewhat the appearance of a bottle-brush; each of these hairs has at the apex two or three branches. Mentum beneath three times as long as wide; labial palpi 4-jointed, first joint as long as the second and third together, apical joint narrower than the others, longer than the third. Submentum elongate, its apex hyaline; lora very strongly developed and thick. Cardines wide and straight.

MACROPIS, *Panz. Faun. Germ.* Hft. 107, p. 16.

(Pl. IV. figs. 7-9.)

Labrum transverse, slightly rounded in front, densely fringed with long hairs intermixed with thicker spine-like bristles; epipharynx sharply angular in front. Scales at the base of the maxillæ curved inwards, subreniform. Maxillæ with the blades sinuate exteriorly, fringed with long hairs at their apex, which is rounded; internal membranous margin very narrow; maxillary palpi 6-jointed. Paraglossæ with their basal portions slightly longer than wide, rounded on its external margin, somewhat angular on its internal, its extreme base bearing a few bristly hairs springing from deep holes; its apical portion elongate, pointed, towards the extremity clothed with bristly hairs. Lingua elongate, subtriangular; its sides slightly rounded, its apex narrowly produced and clothed with long projecting hairs—its base clear and hyaline, the rest finely ridged transversely and set with short hairs. Mentum beneath gradually widening to the apex, about  $3\frac{1}{2}$  times as long as wide; labial palpi 4-jointed,

the basal joint thickest and longest. Submentum widened and hyaline at the apex, narrow and darkly chitinous at the base. Lora distinct, not very long, forming an obtuse angle at their point of juncture.

DASYPODA, *Latr. Hist. Nat.* iii. p. 372. (Pl. V. figs. 1-3.)

Labrum transverse, its anterior edge slightly rounded, densely fringed with long golden hairs, all of which appear to be more or less plumose or spinose. Epipharynx slightly pointed at the apex. Scales at the base of the maxillæ very elongate, oval, set with long porrect, slightly spinose hairs. Maxillæ with the blades very long, gradually rounded on their outer margin, straight on the inner; apex pointed; inner margin almost destitute of any membrane, except just opposite the insertion of the maxillary palpi; these latter are 6-jointed. Paraglossæ narrowed at the base, their inner basal margin rounded and bearing a row of stiff bristles, their outer basal margin concave; across the centre they are widened, from whence the outer apical margins converge in slightly rounded lines, and the inner apical margins diverge in nearly straight lines, and the apex is produced into a narrow, slightly pointed process. Lingua much more elongate than in any of the preceding genera; the transversely ridged portion four times as long as broad, gradually tapering to the apex, which, however, appears to be destitute of the ladle-shaped termination observable in the higher Apidæ. Beneath with the mentum about four times as long as wide, very little widened towards the apex. Submentum long, widened at the apex; labial palpi 4-jointed, the joints much swollen at the apex. Maxillæ clothed with very long spinose hairs; lora very strongly developed, forming an acute angle at their point of juncture.

PANURGUS, *Panz. Krit. Rev.* ii. p. 209. (Pl. V. figs. 4-6.)

Labrum transverse, widened in front, and slightly rounded on its anterior margin, fringed with long spinose hairs of rather unequal lengths. Epipharynx triangular. Scales at the base of the maxillæ ovate, set with strong upright bristles. Maxillæ with the basal portion fringed outwardly with a row of short erect bristly hairs; palpi 6-jointed; blades semiluculent, pointed, gradually narrowed to the apex, with rather a wide membrane on their inner margins towards the base; surface apparently clothed

with exceedingly short hairs. Paraglossæ truncate at the base; the inner margin of the basal portion nearly straight, and almost uniting over the base of the lingua; apices produced into elongate pointed sheaths in shape something like the maxillæ. Lingua elongate, a little more than seven times as long as wide, finely ridged transversely, and with whorls of short bristly hairs; apex simple, with apical spoon-like lobe. Beneath, with the mentum widened towards the apex, about three times as long as its greatest width; labial palpi 4-jointed, the joints narrow and rounded, basal joint very long, longer than the 2nd and 3rd together. Submentum short, pear-shaped, and hyaline. Maxillæ with a tuft of long feathery hairs at the base; lora very feebly developed, formed, as in *Prosopis*, *Colletes*, &c., merely by the chitinized arch of the membrane investing the space between the cardines.

The feebly developed lora and subcylindrical labial palpi, associated with the long pointed paraglossæ and elongate lingua, characterize this genus as one of the most peculiar in our list, especially when it is remembered that in the ♂ genital armature it is also unlike all its congeners.

DUFOUREA, *Lep. Hist. Nat. des Ins., Hym.* ii. p. 226.

Of this rare genus I have only one specimen with its tongue extended, which only shows some of the sclerites, but they evidently are arranged very much as in *Panurgus*. The maxillæ have some long hairs at the base; the lingua hardly extends beyond the apices of these organs. The maxillary palpi are 6-jointed; the labial 4-jointed, all of which are more or less cylindrical, as in the short-tongued genera; the basal joint is almost as long as the two following together. The submentum is short and subhyaline as in *Panurgus*, but there appears to be no thickening of the membrane between the cardines at its apex, as in that genus, and therefore nothing to correspond to the lora; the cardines themselves are very long and straight.

ROPHITES, *Spin. Ins. Lig.* ii. p. 9.

Labrum transverse. Epipharynx triangular, somewhat rounded at the apex. Maxillary palpi long, 6-jointed; blades of the maxillæ rather short, pointed, bearing on their surface some semierect hairs, internal margin membranous. Paraglossæ at the

base ensheathing the base of the lingua; their lateral portions produced into two elongate subfiliform processes, slightly widened and truncate at the apex. Lingua very long and rather thick, clothed with very long hairs. Mentum elongate, trilobate at the apex; labial palpi with the first 3 joints sheath-like, the 1st and 2nd subequal in length, 3rd very short, 4th divergent, cylindrical, about half as long as the 3rd. I have only dried specimens to work from, but the submentum is not recognizable, and the lora are apparently absent; in fact all the sclerites in this portion of the mechanism appear to be on the same plan as in *Sphécodes* and *Halictus*: through the dried membrane that lies between the cardines two elongate sclerites can be clearly discerned; these, I have little doubt, are analogous to the straps observed in the genera above mentioned; the cardines also are very long and thin, as in those genera. These points of resemblance in structure to *Halictus* are most interesting, as the facies of the insects themselves is so completely Halictiform. The shape of the labial palpi, on the other hand, is similar to those of the higher Apidæ, but the paraglossæ are unlike those of any other genus that I know.

NOMADA, *Fabr. Syst. Ent.* p. 388. (Pl. VI. figs. 1-3.)

Labrum transverse, anterior margin rounded, slightly produced in the centre. Epipharynx very long, its sides slightly sinuate, its apex bluntly pointed. At the base of the maxillæ are two suboval chitinized spots, which appear to represent the basal scales. Maxillæ dark outwardly, semiluculent towards their inner margins; palpi very long, 6-jointed; blades pointed and fringed with hairs at the apex, inner margin broadly membranous. Paraglossæ wide, elongate oval at the base, slightly sinuate on their external margins, apex produced into an elongate spine-like process. Lingua elongate, nearly linear, nearly ten times as long as wide, finely ridged and whorled with bristles; apex with a spoon-shaped lobe, although this lobe seems to be retracted (at least in the specimen which I have examined) amongst the apical hairs. Beneath, with the mentum about four times as long as wide; labial palpi 4-jointed, the joints narrow and rounded, 1st joint longer than the other 3 together; submentum very long. Maxillæ with a few long plumose hairs at the base; lora well developed, but short; cardines very long.

This genus forms a curious transition between the Andrenidæ and Apidæ; it has many of the characteristics of the latter division, such as the long tongue, the acute paraglossæ, and the long basal joint of the labial palpi; on the other hand, however, it has the joints of the labial palpi subcylindrical, like the Andrenidæ, without any tendency to the flat or concave sheath-like form of the Apidæ, and its species are also parasitic on the Andrenidæ (with the exception of *N. sexfasciata*, which frequents the burrows of *Eucera*). These last two characteristics seem to me to outweigh the others; and notwithstanding the exhaustive remarks of M. J. Perez on this subject ('Contrib. à la Faune des Apiaires de France,' p. 152 *et seq.*), where he considers *Nomada* as allied to *Megachile*, I should feel inclined to treat it as a very abnormal genus of the Andrenidæ.

EPEOLUS, *Latr. Hist. Nat.* iii. p. 375. (Pl. VII. figs. 7, 8.)

Labrum transverse, its widest portion a little before the base, its sides thence converging towards the apical margin, which is slightly sinuate and bears a small tooth in the centre of the sinuation. Sclerites of the hypopharynx narrow and straight. Scales at the membranous base of the maxillæ represented by two little dark chitinous sclerites, which hardly project beyond the membrane. Maxillæ with their blades rounded at the apex, which bears round its edge a few extremely short hairs, very convex above and concave below, their inner edge slightly curved and rather narrowly membranous; palpi with one joint; under margin of the blades of the maxillæ produced so as nearly to ensheath the lingua &c. when closed. Paraglossæ wide and parallel-sided at the base, shaped something like razor-blades, their cutting-edge inwards; their outer margins thickened and produced at the apex into a long, slightly curved filiform process, extending to about the apex of the 1st joint of the labial palpi. Lingua very long, clothed with rather long hairs; mentum beneath five times at least as long as wide, subparallel-sided; labial palpi with the 1st and 2nd joints sheath-like, 1st once and a third as long as the 2nd, apex of the 2nd with a fringe of long hairs, 3rd and 4th joints cylindrical, 4th shorter than the 3rd; submentum elongate, widened at the apex; lora rather elongate, strongly developed; cardines thick and curved.



MELECTA, *Latr. Hist. Nat.* xiv. p. 48. (Pl. VIII. figs. 3, 4.)

Labrum almost as long as wide, slightly narrowed, and truncately rounded in front, densely clothed with long, shortly branched hairs. Epipharynx very long, narrow, and pointed; at the side of each sclerite of the hypopharynx near the base, the investing membrane is chitinized into a dark plate, a character I have only seen in this genus. At the base of the maxillæ, lying on the membrane, are two long dark chitinous plates which I believe represent the basal scales. Maxillæ nearly black on the basal portion outwardly, membranous inwardly, bearing the sclerites mentioned above; palpi rather short, 4-jointed; blades forming two very concave sheaths, the superior portion narrow, with only a very narrow membranous edge towards the apex of their inner margins; apices with a few very short hairs. Paraglossæ very long, narrow and pointed, extending almost to the apex of the maxillæ. Lingua very long, narrow, slightly constricted at the extreme base. Beneath, with the mentum very long; labial palpi 4-jointed; 1st joint more than three times as long as the 2nd; 3rd and 4th subequal, together not quite half so long as the 2nd; 1st and 2nd joints flat, and somewhat sheath-like; 3rd and 4th cylindrical. Submentum elongate and parallel-sided, except at the extreme apex; lora and cardines very long.

CÆLIOXYS, *Latr. Gen. Crust. et Ins.* iv. p. 166.

(Pl. VI. figs. 4-6.)

Labrum longer than wide, parallel-sided; its apex abruptly truncate. Epipharynx hidden beneath the labrum. Scales at the base of the maxillæ strongly developed, elongate oval, fringed with long hairs, their bases hidden in the specimen before me by the labrum; sclerites of the hypopharynx strongly developed. Maxillary palpi two-jointed; apical joint very small and narrow; blades of the maxillæ pointed, submembranous, with a strong thick midrib from which a series of beautifully fine parallel striæ extend on to the membrane at each side, those on the inner side extend about halfway across the membrane, those on the outer side, which is convex, appear to extend to the exterior margin, and on the reverse or concave underside of the blade appear as ridges, which under a  $\frac{1}{2}$ -inch objective may be

seen to be set with rows of fine short golden hairs. Lingua long, not constricted at the base; on the membranous covering of the upper surface of the mentum are two elongate, subparallel, narrow, slightly sinuate sclerites extending almost to the junction of the labial palpi; beyond these at their apical ends are two others, which diverge rather rapidly and apparently terminate near the base of the lingua; these latter seem to me to be a portion of the paraglossæ, and to represent the broad basal portion of those organs so largely developed in the short-tongued bees; the rest of the paraglossæ, *i. e.* their apical portion, appears beneath the membrane which invests the root of the lingua and extend as two straight narrow sheath-like bodies to about the apex of the 1st joint of the labial palpi. Mentum beneath slightly widened to the apex, three times or more as long as wide; 2nd joint of labial palpi twice as long as the 1st, with its inner margin submembranous; 3rd and 4th very short, cylindrical. Submentum very elongate and narrow; lora short and wide; cardines much curved, and widened about the middle.

MEGACHILE, *Latr. Hist. Nat.* xiv. p. 51. (Pl. VIII. figs. 1, 2.)

Labrum shaped much as in *Cælioxyis*, longer than wide, with nearly parallel sides and abruptly truncate apex; epipharynx hidden beneath it; scales at the base of the maxillæ stipitate, their blades about four times as long as wide, parallel-sided, and truncate at the apex, inner margins set with bristly hairs; maxillary palpi 2-jointed, blades of the maxillæ as in *Cælioxyis*, and all the upper sclerites of the mentum, paraglossæ, &c. scarcely differing from those of that genus; the first joint, however, of the labial palpi is longer, almost equalling the 2nd. For the mentum &c. the description of *Cælioxyis* will practically apply.

ANTHIDÆ, *Fabr. Syst. Piez.* p. 364. (Pl. VIII. figs. 5-7.)

In this genus again the cibarial apparatus is almost identical in form with the preceding, but the maxillary palpi are only one-jointed; and the outer half of the blades of the maxillæ are more deeply striate and set with stronger bristles; the sclerites also, which connect the mentum with the maxillæ and form the continuation of the sclerites of the hypopharynx, are much curved, a large portion of the curves showing on each side, and unite with

the mentum quite at the base instead of about a quarter of its length from it; the lora are very wide at their bases; the cardines long and slightly curved.

STELIS, *Panz. Krit. Rev.* ii. p. 246.

Of this I have only dried specimens, but the sclerites all appear to be arranged as in *Anthidium*; but the 2nd joint of the labial palpi is nearly twice as long as the 1st, and the 3rd is widened and somewhat flat, about equal in length to the 4th.

OSMIA, *Panz. Krit. Rev.* ii. p. 230. (Pl. VII. figs. 4-6.)

Labrum elongate, as in the preceding genera, but more rounded at the sides. Scales at the base of the maxillæ very strongly developed, subparallel-sided for two-thirds of their length, the outer sides thence rounded to the apex; inner margins set with long hairs; maxillary palpi 4-jointed; blades very long and pointed, with a strong longitudinal rib. Sclerites of the membranous covering of the mentum as in *Cælixys*, &c.; those of the upper part of the paraglossæ longer and narrower; the lower or blade-like portion of the paraglossæ rounded at the apex, and extending to about three-fifths of the length of the 1st joint of the labial palpi. Lingua very elongate; labial palpi with the 2nd joint once and a half as long as the 1st; apical joints very short; sclerites connecting the maxillæ with the mentum, joining the latter close to its base; submentum very long and narrow, widened at the apex; lora elongate, wide at their bases; cardines rather narrow and slightly curved.

CHELOSTOMA, *Latr. Gen. Crust. et Ins.* iv. p. 161.

(Pl. VII. figs. 1-3.)

Labrum elongate, slightly sinuate at the sides, truncate or slightly emarginate in front. Scales of the maxillæ hidden beneath the labrum. Maxillary palpi 3-jointed; blades of the maxillæ broadly membranous on their inner margin. Sclerites of the upper surface of the mentum as in *Cælixys*, &c.; those of the paraglossæ which were noted in that genus as apparently belonging to those organs, here show their connexion most plainly, and appear as elongate divergent dorsal plates, whereas the rest of the paraglossæ, extending below and beyond them, forms a sort of lateral sheath to the base of the lingua, its upper edge being set with bristly hairs. Lingua elongate, linear,

nearly twice as long as the first two joints of the labial palpi. Mentum beneath about  $3\frac{1}{2}$  times as long as wide, slightly widened towards the apex, where it is deeply trilobate. Labial palpi with the first three joints sheath-like, and only the apical one cylindrical and divergent; the basal joint is very short, not a quarter so long as the 2nd, the 3rd is about half as long as the 1st, and the 4th distinctly longer than the 3rd. (I must here correct an error which, I regret to see, occurs in my synopsis, Trans. Ent. Soc. Lond. 1884, p. 213. I there say of the labial palpi "apical joint much shorter than 3rd;" and I may remark also that F. Smith, in his 'Catalogue of British Hymenoptera,' pt. 1, figures this genus on pl. viii. as having the apical joint very short, and I fear I must have taken my measurements from him.) Submentum short, in the form of an elongate triangle; lora strongly developed; cardines long and slightly curved.

HERIADES, *Spin. Ins. Lig.* ii. p. 7.

I have only dry specimens of this genus, but the maxillæ and the upper sclerites of the mentum and the paraglossæ appear to be arranged much as in *Chelostoma*; the labial palpi differ from those of the species of that genus in having the terminal two joints divergent and cylindrical, instead of only the terminal one; the submentum is very elongate, and the lora has very long arms; the maxillæ at the base are clothed with very long plumose hairs; the cardines are long and straight.

EUCERA, *Scop. Ann. Hist. Nat.* iv. p. 8. (Pl. IX. figs. 1-3.)

Labrum semicircular; epipharynx angularly pointed; membranous base of the maxillæ bearing two small narrow sclerites, widening towards their apex and approaching each other apically, dark at their base and nearly hyaline at their apex; at the base of the hyaline portion near its exterior margin is a small dark spot out of which rises a bristle, and there are two other bristles emerging from the dark portion. These sclerites appear to me to be homologous with the scales in the other genera, although much less developed; from their bases extend two other much larger sclerites, of a pale horn-colour, elongate, slightly widened at the apex, adpressed to the membrane, with their exterior apical angles rounded; they reach almost to the base of the dark opaque portion of the maxillæ: I have seen nothing like them in

any other genus; whether they are branches of the scales or what I cannot say, but they appear to be connected with them. Maxillary palpi 5-jointed; blades of maxillæ widely membranous on their inner margin, especially at the apex; the thickened external rib produced at the apex in the form of a hook: base or dorsal plates of the paraglossæ, when these organs are closed, ensheathing the base of the lingua; the lateral portions of the paraglossæ extend from behind the middle of the dorsal sheath in very long, slightly curved processes to beyond the apices of the labial palpi; their inner margins widely membranous at the base, the membrane gradually narrowing towards the apex, and disappearing at a point about a quarter of the entire length of the paraglossæ from the apex. Lingua very elongate; mentum beneath elongate, parallel-sided, receiving the sclerites of the hypopharynx near the base; 1st and 2nd joints of labial palpi very wide, their inner margins widely membranous, 1st nearly twice the length of the 2nd, 3rd and 4th short, cylindrical and divergent. Submentum very long; arms of the lora very long and strongly developed; cardines wide and slightly curved; base of the maxillæ clothed with very long plumose hairs.

ANTHOPHORA, *Latr. Nouv. Dict. d'Hist. Nat.* ix. p. 167.

(Pl. IX. figs. 7-9.)

In this genus the labrum is transverse, largely rounded in front, the apex of the epipharynx shows beyond it, narrow, truncate at the apex, with the corners of the truncature rounded. The scales of the maxillæ are oval, strongly developed, and set with strong testaceous bristles along their margins. The sclerites of the hypopharynx are very divergent, and extend under the maxillæ to beyond their palpi, whence they approach the submentum at right angles, just at its juncture with the mentum. The maxillary palpi are 6-jointed; the blades of the maxillæ are long, narrow, convex above, with a narrow parallel membranous inner margin, through which, near the apex, a few hairs can be seen fringing the thicker portion on its concave side. Sides of the mentum produced and folded over the upper surface, their edges touching each other for a short distance about the middle and then diverging rapidly to the base of the labial palpi; these are attached more laterally than in any of the preceding genera, and their attachment can be plainly seen from above; the basal



joint is exceedingly long and sheath-like, its inner margin widely membranous, and its midrib set with hairs; these hairs much resemble those of the maxillæ, which show through the membranous inner margin of those organs in so many genera; the 2nd joint is about a third as long as the 1st, also sheath-like; the 3rd and 4th are very short, subequal, cylindrical, and divergent. Beyond the divergent sides of the mentum above are seen two sclerites which terminate at the base of the paraglossæ; these latter organs are most strongly developed; their bases are truncate, their inner edges overlap, thus forming a complete dorsal sheath for the base of the tongue; the apices of these dorsal sheaths are rounded exteriorly; from about their middle originate the lateral or blade-like portions of the paraglossæ, which extend as latero-ventral sheaths to about as far again as the dorsal ones—*i. e.*, to about two thirds of the length of the 1st joint of the labial palpi. The lingua is exceedingly long, longer than in any other genus of our British Anthophila; the base of the lingua beneath is also sheathed by two sclerites, which appear to be ventral portions of the paraglossæ. Mentum subparallel-sided, at the apex emarginate, but with its centre produced into a pale angular process; submentum exceedingly long and narrow; arms of the lora short but wide at their union; cardines short and narrow.

SARPODA, *Latr. Gen. Crust. et Ins.* iv. p. 177.

(Pl. IX. figs. 4-6.)

Only distinguishable generically from *Anthophora* by the 4-jointed maxillary palpi and the 2-jointed labial palpi, both of which are sheath-like. How F. Smith and Dours managed to find a 3rd and 4th joint I fail to understand.

CERATINA, *Latr. Hist. Nat. Ins.* xiv. p. 50.

Of this genus I have only dried specimens. Labrum subquadrate; epipharynx long and pointed; scales at the base of the maxillæ largely developed, bearing a few long hairs. Maxillary palpi 6-jointed; blades of the maxillæ with their inner margin widely membranous, through which can be seen the long hairs that fringe the thicker part of the blade on its underside. Paraglossæ sheath-like, their apices situated at about two-fifths of the length of the 1st joint of the labial palpi from its base.

Lingua very elongate. Mentum elongate; labial palpi with the first two joints sheath-like, the 2nd nearly as long as the 1st, 3rd and 4th very short, divergent; submentum very long, and the arms of the lora likewise.

*PSITHYRUS*, *Lep. Ann. Soc. Ent. Fr.* ii. (Pl. X. figs. 1-3.)

Labrum transverse, widely rounded in front, the centre of the front margin slightly produced; epipharynx triangular; scales of the maxillæ small, but bearing several long bristles. Maxillary palpi 2-jointed; blades of the maxillæ elongate, their apices slightly incurved and hook-like, their inner margins widely membranous, showing the hairs which fringe the thicker part of the blade beneath very clearly. Paraglossæ with their dorsal plates pointed at the apex, the base bearing a few lateral hairs; lateral portions sheath-like, rounded at the apex. Lingua very long. Mentum beneath parallel-sided, truncate at the apex; 1st and 2nd joints of the labial palpi very wide and sheath-like, with wide membranous inner margins, 2nd about one fourth as long as the 1st, 3rd and 4th very short, cylindrical and divergent. Submentum shortly pyriform. Sclerites of the hypopharynx joining the mentum at some distance from the base; lora with short curved arms; cardines nearly straight.

*BOMBUS*, *Latr. Hist. Nat. Ins.* xiv. p. 63. (Pl. X. figs. 4-6.)

So like *Psithyrus* in all its details that there really is no object in giving a special description of them; for particulars, therefore, see that genus.

*APIS*, *Linn. Syst. Nat.* ed. x. 1. p. 574. (Pl. X. figs 7, 8.)

Labrum widely transverse, rounded in front; epipharynx pointed; scales at the base of the maxillæ not represented as far as I can see. Maxillary palpi 1-jointed; blades of the maxillæ very widely membranous inwardly, their apices with a few short bristly hairs. Paraglossæ ensheathing the lingua at its base, produced at their apices into two rounded, hyaline lobes; lingua elongate. Mentum beneath short, twice and a quarter as long as wide, its apex truncate. Labial palpi with the 1st joint widely membranous on its external margin, fringed with long hairs on its internal margin, and set with long stiff bristles on its dark

central portion; 2nd joint not a sixth as long as the 1st, 3rd and 4th divergent, very short, cylindrical. Submentum short and triangular; lora with the arms short but well developed; cardines very slightly curved. In the queen all the parts are shorter and stouter.

## EXPLANATION OF THE PLATES.

## PLATE III.

- Fig. 1. *Colletes*: anterior view.  
 2. „ posterior view.  
 3. *Prosopis*: anterior view.  
 4. „ posterior view.  
 5. „ lingua paraglossæ.  
 6. *Sphecodes*: anterior view.  
 7. „ posterior view.  
 8. „ lingua paraglossæ.  
 9. *Halictus*: anterior view.  
 10. „ posterior view.  
 11. „ base of lingua paraglossæ.

## PLATE IV.

- Fig. 1. *Andrena*: posterior view.  
 2. „ anterior view.  
 3. „ base of lingua paraglossæ.  
 4. *Cilissa*: anterior view.  
 5. „ posterior view.  
 6. „ lingua paraglossæ.  
 7. *Macropis*: anterior view.  
 8. „ posterior view.  
 9. „ lingua paraglossæ.

## PLATE V.

- Fig. 1. *Dasypoda*: anterior view.  
 2. „ posterior view.  
 3. „ lingua paraglossæ.  
 4. *Panurgus*: anterior view.  
 5. „ posterior view.  
 6. „ base of lingua paraglossæ.

## PLATE VI.

- Fig. 1. *Nomada*: anterior view.  
 2. „ posterior view.  
 3. „ base of lingua paraglossæ.  
 4. *Cælioxyis*: anterior view.  
 5. „ posterior view.  
 6. „ base of lingua paraglossæ.

## PLATE VII.

- Fig. 1. *Chelostoma* : anterior view.  
 2.     "           posterior view.  
 3.     "           base of lingua paraglossæ.  
 4. *Osmia* : anterior view.  
 5.     "           posterior view.  
 6.     "           base of lingua paraglossæ.  
 7. *Epeolus* : posterior view.  
 8.     "           anterior view.

## PLATE VIII.

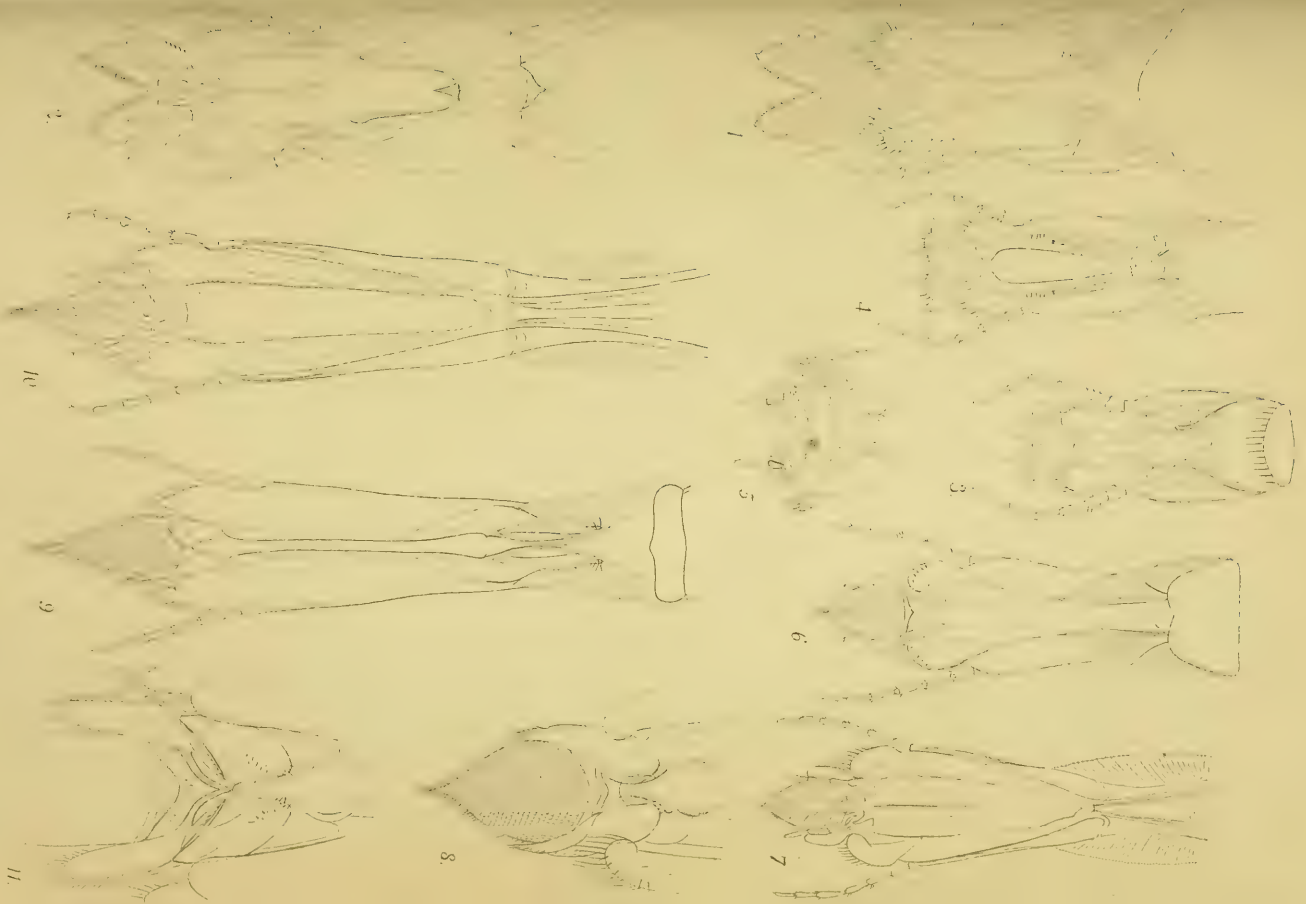
- Fig. 1. *Megachile* : anterior view.  
 2.     "           posterior view.  
 3. *Melecta* : anterior view.  
 4.     "           posterior view.  
 5. *Anthidium* : posterior view.  
 6.     "           anterior view.  
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## PLATE IX.

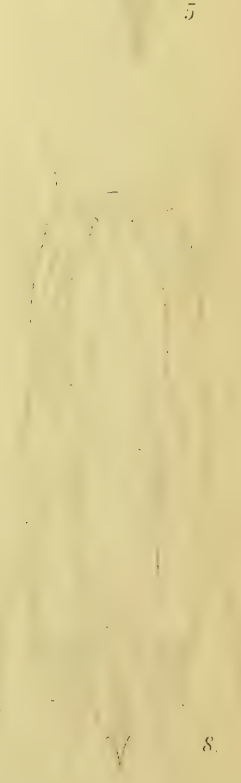
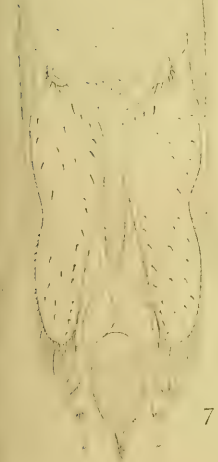
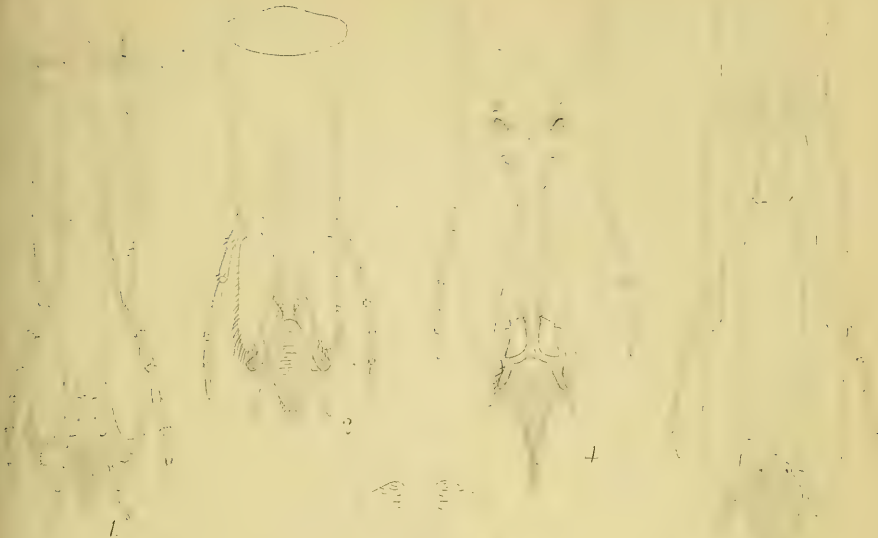
- Fig. 1. *Eucera* : anterior view.  
 2.     "           posterior view.  
 3.     "           base of lingua paraglossæ.  
 4. *Saropoda* : anterior view.  
 5.     "           posterior view.  
 6.     "           base of lingua paraglossæ.  
 7. *Anthophora* : anterior view.  
 8.     "           posterior view.  
 9.     "           base of lingua paraglossæ.

## PLATE X.

- Fig. 1. *Psithyrus* : anterior view.  
 2.     "           posterior view.  
 3.     "           base of lingua paraglossæ.  
 4. *Bombus* : anterior view.  
 5.     "           posterior view.  
 6.     "           base of lingua paraglossæ.  
 7. *Apis* : posterior view.  
 8.     "           anterior view.
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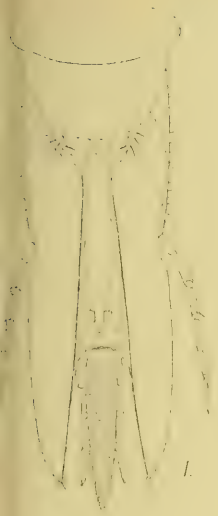




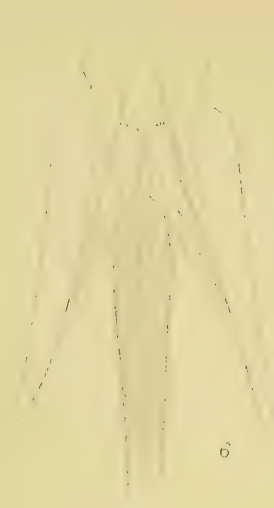


TONGUES OF HYMENOPTERA ANTHOPHILA.

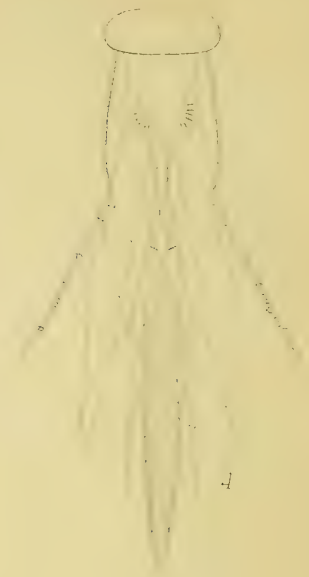
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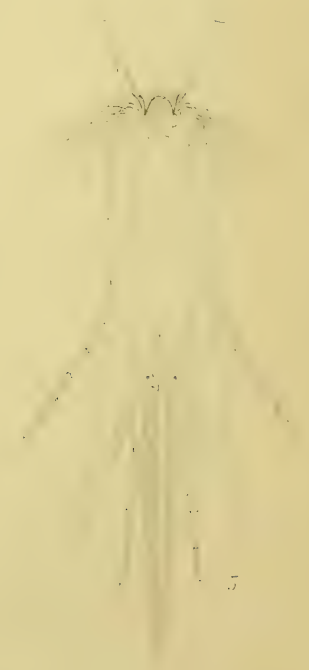
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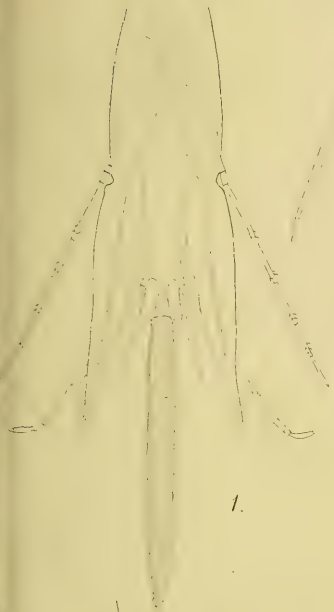


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TONGUES OF HYMENOPTERA ANTHOPHILA.



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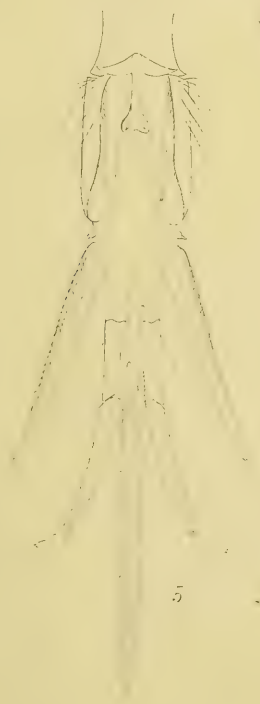
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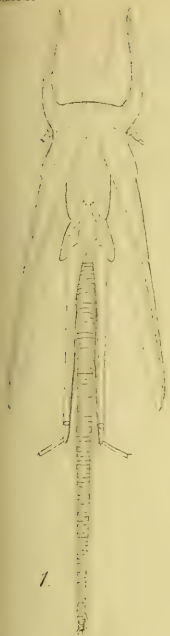
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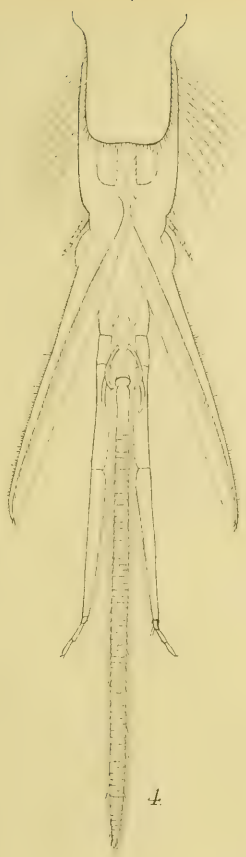
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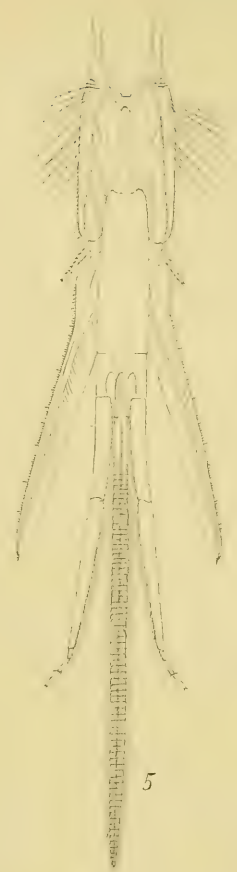
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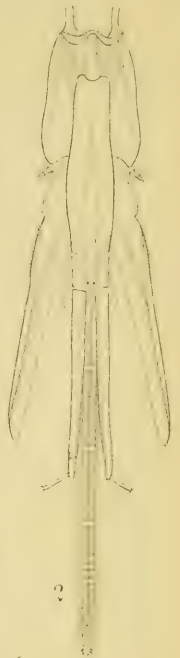
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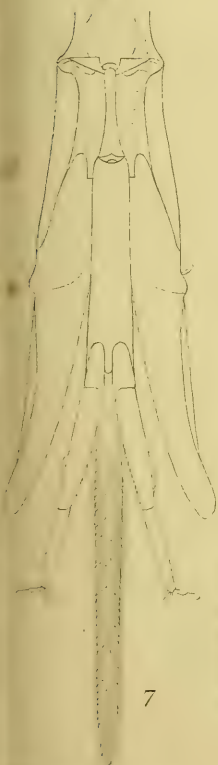
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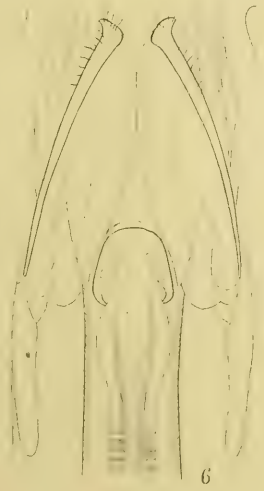
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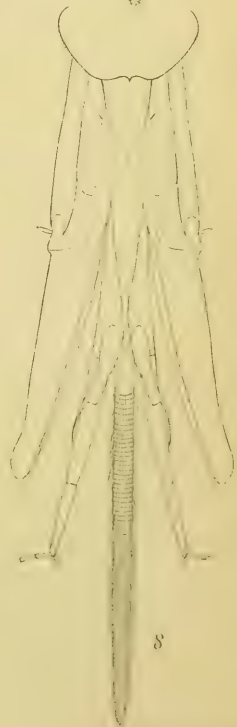
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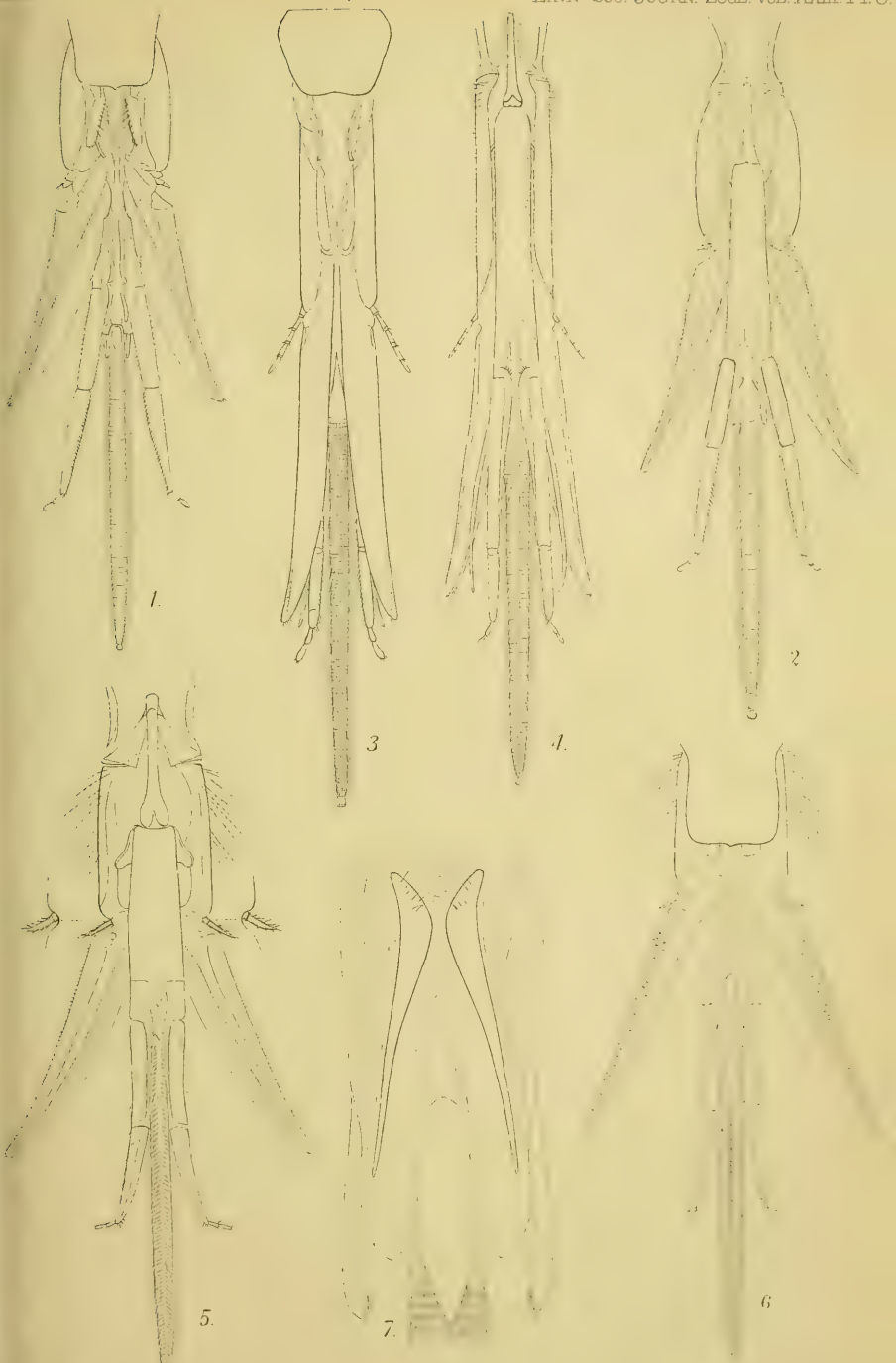


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W. G. Cresson del. E. Cresson sc.

Mintern Eros imp.

TONGUES OF HYMENOPTERA ANTHOPHILA.

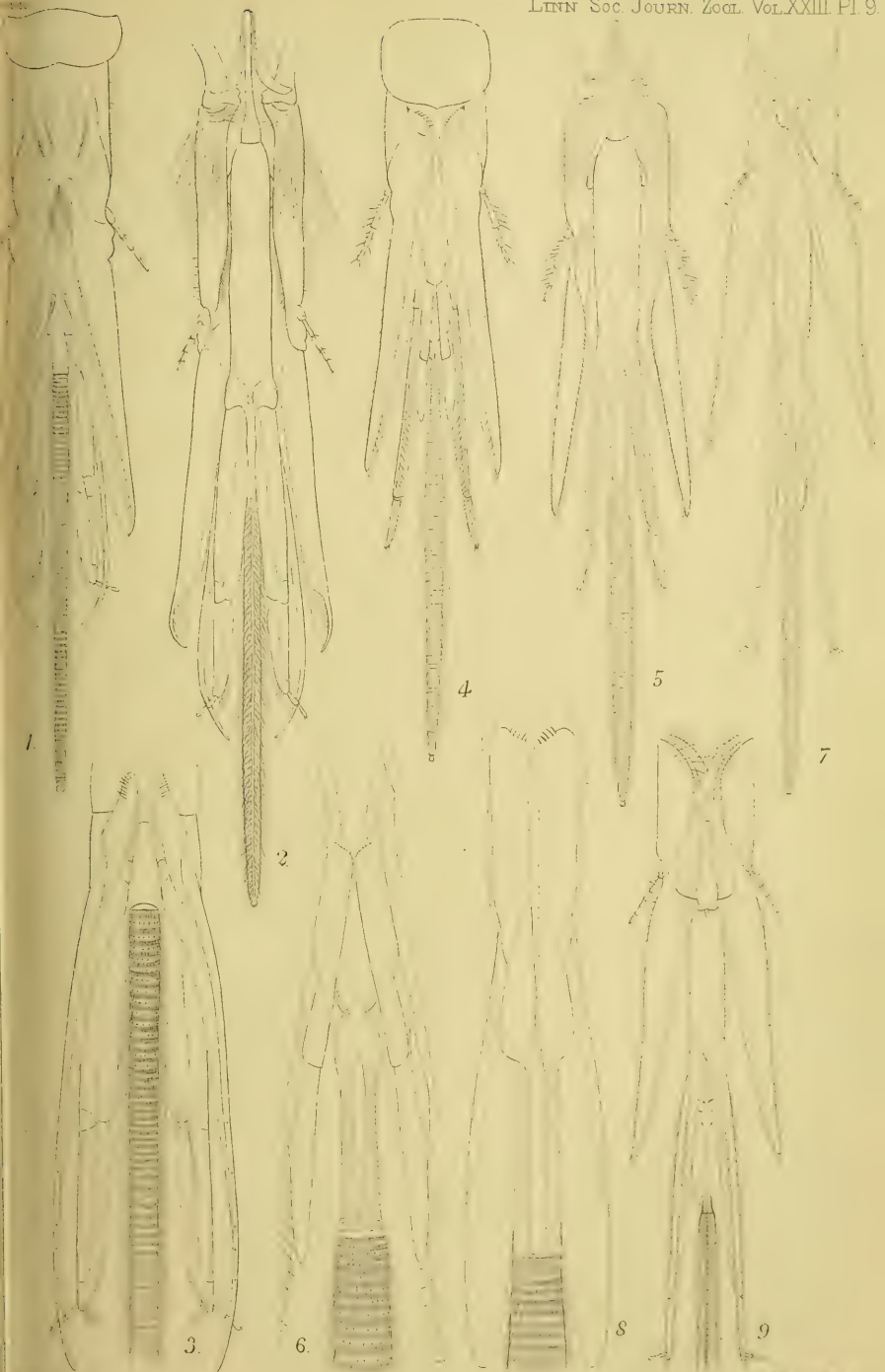


Saunders del. E. Carter sc.

Western Bros imp.

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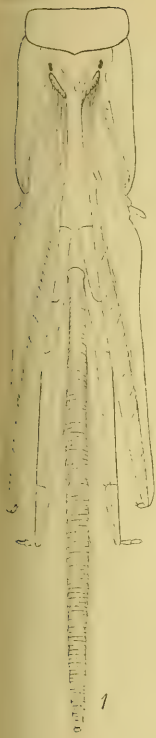




Wheeler del. E. Carter sc.

Mutters. Pinx. del.

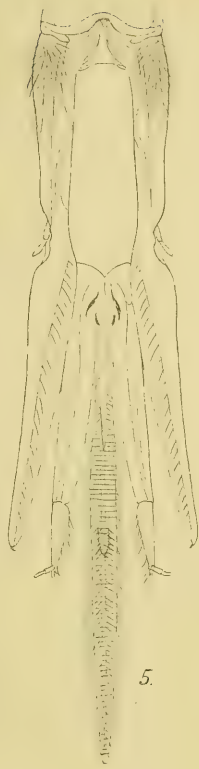
TONGUES OF HYMENOPTERA ANTHOPHILA



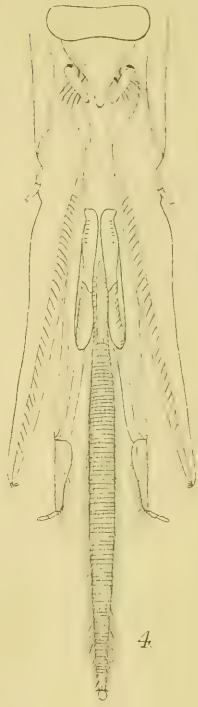
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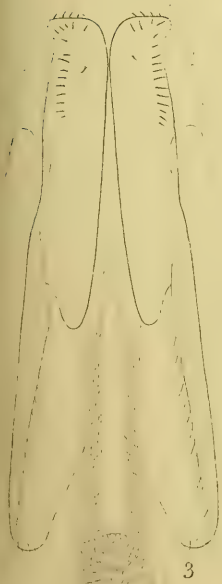
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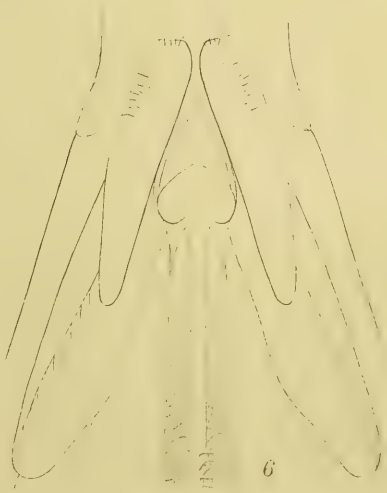
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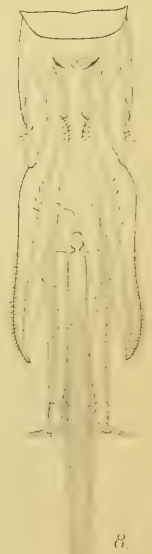
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TONGUES OF HYMENOPTERA ANTHOPHILA.